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THE RELATIVE SUSCEPTIBILITY OF CERTAIN BEAN VARIETIES TO INFESTATION BY MAJOR PESTS AT FAYOUM GOVERNORATE

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ABSTRACT

Eight varieties of faba bean were tested for infestation susceptibility by the major pests, jassid *Empoasca decipiens* Paoli, white fly *Bemisia tabaci* Genn., aphid *Aphis craccivora* Koch., bean fly *Liriomyza congesta* and red spider mite *Tetranychus urtica* Koch., at Fayoum Governorate. The experiment was conducted during the period 10 Dec. 1990 to 1 Apr. 1991. Data of pest infestation were treated by advanced statistical methods, such as correspondence analysis and ascending hierarchic classification. Results obtained show that all bean varieties are susceptible to infestation by the above mentioned pests but in different degrees and at different stages. Generally, less susceptible varieties are Giza 402, Giza 503 and Giza 523, and highly susceptible bean varieties are Giza 406, Giza 502, Giza 605, Giza 606 and Giza 669. The most important factors affecting pest infestation are the interchange or organisms among regions and even among crops and the monoculture system.

RESUME

Au gouvernorat de Fayoum, 8 variétés de féveroles ont été testées pour détecter leur susceptibilité aux principaux fléaux, à savoir : jassid *Empoasca decipiens* Pooli, la mouche blanche *Bemisia tabaci* Genn., les aphides *Aphis cracciavora* Koch., la mouche de l'harricot *Liriomzya congesta* et l'araignée rouge *tetranychus urticae* Koch. L'expérience fut menée pendant la période du 10 décembre 1990 au premier Avril 1991. Les données concernant l' infestation par les insectes ont été traitées a l'aide de méthodes statistiques évoluées, telles que l'analyse par corespondance et la classification hiérarchique ascendente. Les résultats obtenus ont montré que toutes les variétés de féveroles sont susceptibles a l'infestation par les insectes sus-mentionnés mais à des degrés différents et à des stades différents. En générales les variétés les moins susceptibles sont guiza 402, guiza 503 et guiza 523 et les variétes hautement susceptibles sont guiza 406, guiza 502, guiza 605, guiza 606 et guiza 669. Les principaux facteurs qui affectent l'infestation sont l'alternance des organismes parmi les régions et même parmi les récoltes et la monoculture.

INTRODUCTION

Bean (Vicia faba L.) is one of the most important crops in Egypt. It is considered of great nutritive value, containing relatively high percentage of protein and fat, in addition to sever-

al vitamins and some essential elements. Field observations revealed that this crop is usually attacked by several pests, among which are thrips *Thrips tabaci* Lind., jassid *Empoasca decipiens* Paoli, white fly *Bemisia* tabaci Genn., aphid *Aphis craccivora* Koch., bean fly *Liriomyza congesta* Becker and red spider mite *Tetranychus urticae* Koch.

Studies on faba bean are very limited and deal with the effect of sowing date, cultivars and plant density on growth (Zeidan et al. 1986a) and productivity (Zeidan et al. 1986b) and the effect of planting data on pest infestation (Zedan et al., 1991).

The present investigation was therefore planned to evaluate the relative susceptibility of certain bean varieties to infestation by the major pests at Fayoum Governorate, Middle Egypt.

MATERIALS AND METHODS

The experiment was conducted in the field of El-Hadka village in Fayoum city district, Fayoum Governorate during 1990 season. Eight Egyptian bean varieties were tested, they were Giza 402, Giza 406, Giza 502, Giza 503, Giza 523, Giza 605, Giza 606 and Giza 669, each cultivated in 1/10 feddan in 4 randomized plots (each 105 m2). Sowing date was 28 Oct. 1990. Normal agricultural practices were followed and left without chemical control.

Estimation of infestation by the major pests (mites and insects) was conducted after seven weeks from plantation. Ten randomized leaves were picked from plants of each replicate at 10-day intervals (±2). Number of mites and white fly larvae per one square inch of leaf area were counted on the lower surface of each leaflet (Hoda and Doss 1984), while jassid, bean fly and aphid were counted on the whole leaflet by means of a stereoscopic microscope.

The data of pest infestation were treated by means of multivariate statistical methods, correspondence analysis CA (Greenacre 1984) and ascending hierarachic classification AHC (Roux 1985). The computer calculations for CA and AHC were carried out at Cairo University using DATAVISION programme 1.2 (Roux 1987).

RESULTS

Results of infestation with the jassid *Empoasca decipiens* Paoli, the bean fly *Liriomyza congesta* Becker, the aphid *Aphis craccivora* Koch., the whitefly *Bemisia tabaci* Genn. and the red spider mite *Tetranychus urticae* Koch. are shown in Tables (1 and 2).

Analysis of variance of data obtained during the study period indicated the presence of significant differences between the means of sampling dates, while differences between the means of bean varieties are insignificant. This reveals that all bean varieties studied were indiscriminately attacked by the pests mentioned above at different plant ages.

Figs. 1 - 5 show results of the application of CA and AHC methods to data of infestation by each of the above mentioned pests. Application to data of infestation by *E. decipiens* is shown in Fig. (1). 46 % of the total variance is associated with the first (horizontal) axis

TABLE 1. Infestation rate (ind./leaflet) of *E. decipiens, L. congesta* and *A. craccivora* on faba bean varieties at nearly 10-day intervals during the period from Oct. 1990 to Apr. 1991.

No	Date	Giza 402 A	Giza 406 B	Giza 502 C	Giza 503 D	Giza 523 E	Giza 605 F	Giza 606 G	Giza 669 H
		Empoasca decipiens							
1	10 Dec. 90	0	0.50	0.50	0	0.25	1.0	0.25	0.50
2	20	0.50	0.50	0.50	0.50	0.75	1.25	0.50	0.25
3	30	0.50	0	0.25	1.00	0	0.50	0.75	0.50
4	10 Jan. 91	0.25	0.50	0.50	0.25	0	0.50	0.25	0.50
5	20	0	0	1.25	0	0.25	1.75	0.25	0.25
6	1 Feb.	0	0.25	0	0	0	0.25	0	0
7	10	0	0	0	0	0	0	0	0.25
8	20	0.25	0	0.25	0	0.25	0.25	0.25	0.25
9	2 Mar.	0.50	0	0	0	0	2.50	1.00	1.00
10	10	0.25	0.50	0.50	0	0.25	0.25	0.25	0.25
11	20	0	0.25	0.25	0.50	0.75	1.00	0.75	1.25
12	1 Apr.	2.25	7.50	4.00	2.50	3.00	2.25	2.00	4.00
	mean	0.38	0.83	0.67	0.40	0.46	0.96	0.52	0.75
		Liriomyza congesta							
1	10 Dec. 90	0	0.75	0	0	0	0.25	0	0
2	20	1.25	0	0.50	1.00	1.25	0.25	1.00	0.75
3	30	1.00	0.25	1.00	2.00	1.25	1.25	2.50	2.00
4	10 Jan. 91	1.50	0.25	1.25	0.50	0.25	0.75	1.00	1.25
5	20	0.25	1.00	1.00	0	0.50	1.25	0.75	1.00
6	1 Feb.	1.25	1.00	0	0	0.75	1.50	0	0.50
7	10	0.25	1.75	0	0.75	0.50	1.00	0.75	0.50
8	20	1.25	0.75	3.25	2.50	3.00	2.25	3.25	1.75
9	2 Mar.	7.50	7.00	4.50	4.75	2.75	7.75	7.50	8.50
10	10	3.50	4.25	5.50	5.75	3.50	3.25	5.00	7.00
11	20	4.25	4.00	4.25	5.00	4.25	5.50	5.50	7.50
12	1 Apr.	3.25	5.25	4.00	1.75	5.25	4.00	5.75	7.25
	mean	2.10	2.15	2.10	2.00	1.94	2.42	2.75	3.15
		Aphis craccivora							
1	10 Dec. 90	0	0	0	0	0	0	0	0
2	20	0	0	0.25	0	0	0	0	0
3	30	0.50	0.50	0	0	0.50	0	1.00	0
4	10 Jan. 91	0	0.50	0	0	0	0.50	0	0
5	20	0	0.50	0.25	0	0	0.50	0.25	0
6	1 Feb.	0	0	0	0	0	0	0	0
7	10	0	0	0	0	0	0	0	0
8	20	0	0	0	0	0	0	0.25	0
9	2 Mar.	0.25	0	0	0	0	0.50	9.25	0
10	10	0	0	0	0	0	0	0	0.25
11	20	0.25	0	1.25	0.25	0	0.50	1.50	0
12	1 Apr.	0	0	0.25	0	0	0	0	0
	mean	0.08	0.13	0.17	0.02	0.04	0.17	1.02	0.02

TABLE 2. Infestation rate (ind./inch) of *B. tabaci* and *T. urticae* on faba bean varieties at nearly 10-day intervals during the study period from Oct. 1990 to Apr. 1991.

No	Date	Giza 402 A	Giza 406 B	Giza 502 C	Giza 503 D	Giza 523 E	Giza 605 F	Giza 606 G	Giza 669 H
		Bemisia tabaci							
1	10 Dec. 90	113.75	21.75	64.50	49.00	41.75	91.50	143.75	55.50
2	20	10.00	7.50	14.50	12.00	12.50	18.75	23.75	30.00
3	30	22.25	4.25	30.75	20.00	41.55	13.25	14.75	31.50
4	10 Jan. 91	1.25	2.25	2.75	18.00	4.50	4.50	14.25	2.75
5	20	0.25	0.75	4.25	0.25	1.75	0.25	2.50	0.50
6	1 Feb.	0.50	0	3.50	0.75	0.50	1.25	0	2.00
7	10	10.50	0.75	1.00	2.00	3.25	8.00	3.25	0
8	20	0	0.25	0.50	0	0.75	0.75	2.25	0
9	2 Mar.	0	0.50	0.75	0	0.75	3.25	1.00	3.00
10	10	0	0	1.00	0.50	0.	0	0	0.50
11	20	0	0	0.50	0.25	1.00	1.25	1.00	0.75
12	1 Apr.	0	0	0	0	0	0	0	0
	mean	13.21	3.17	10.33	8.56	8.98	11.90	17.21	10.54
		Tetranychus urticae							
1	10 Dec. 90	0	0	0	0	0	0	0	0
2	20	0	0	0	0	0	0.25	0.25	0
3	30	0.50	0	0	0	0.75	0	0	0
4	10 Jan. 91	0	0	0	0	0	0	0	0
5	20	0	0	0	0	0	0	0	0
6	1 Feb.	0	0	0	0	0	0	0	0
7	10	0	0	0	0	0	0	0	0
8	20	0	0	0	0	0	0	0	0
9	2 Mar.	0	0	0	0	0	0	0	0
10	10	0	0	0	0	0	0	0	0
11	20	0	0	0	0	0	0	0	0
12	1 Apr.	2.25	18.00	1.0	1.75	24.75	0	0.75	1.50
	mean	0.23	1.50	0.08	0.15	2.13	0.02	0.08	0.13

and 23 % with the second (vertical) one. Giza 406, Giza 502 and Giza 523 bean varieties are more infested on 10 Mar. and 1 Apr. 1991 samplings. Giza 402 and Giza 503 bean varieties are more infested on 30 Dec. 1990 and 10 Feb. 1991 samplings. Giza 605, Giza 606 and Giza 669 bean varieties are more infested on, nearly all sampling dates.

Application to data of infestation by the bean fly *L. congesta* is shown in Fig. (2). 47 % of the total variance is associated with the first axis and 18 % with the second one. The first sampling data is an outlier point on the diagram, and separated from other sampling dates in the figure. Giza 402, Giza 406 and Giza 605 bean varieties are more infested during 20 Jan. - 10 Feb. 1991 and 2 Mar. 1991 sampling dates. The rest of bean varieties are more infested during other sampling dates.

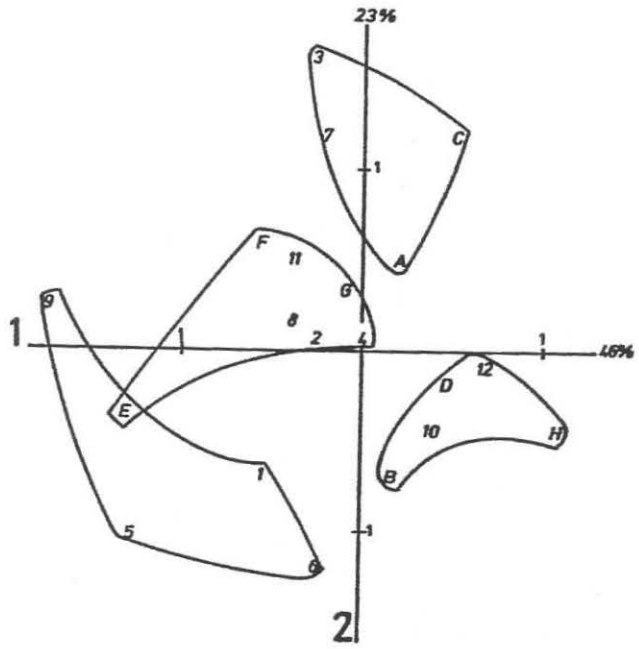

Figure 1. Ordination and Classification of data of *Empoasca decipiens* of Table (1). Symbols : bean varieties (A-H) and sampling dates (1-12) are as shown in Table (1).

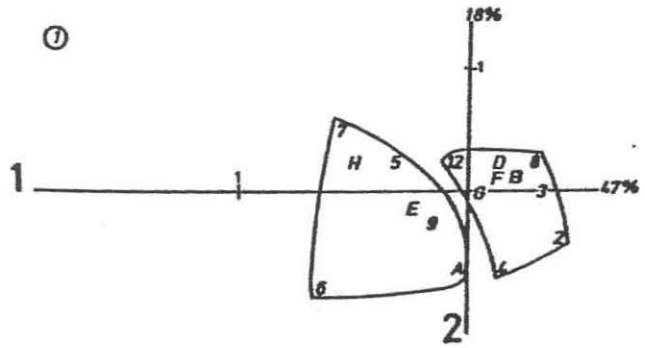

Figure 2 . Ordination and Classification of data of *Liriomyza congesta* of Table (1). Symbols are the same as in Fig. (1). Point C is with B, 10 is with F and 11 is with G.

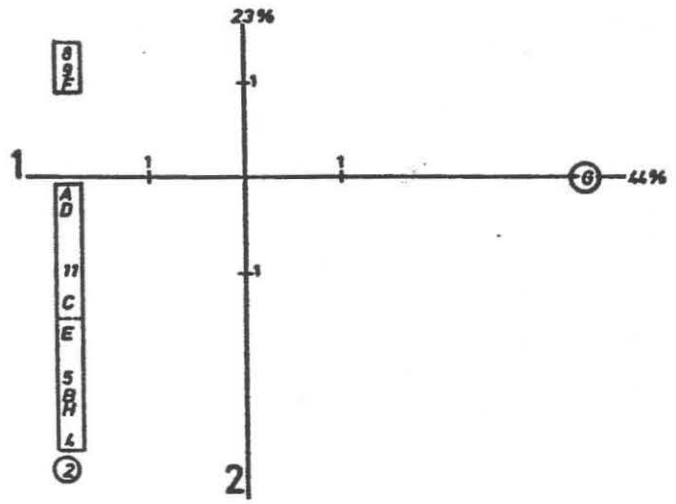

Figure 3. Ordination and Classification of data of *Aphis craccivora* of Table (1). Symbols are the same as in Fig. (1). Point 10 is with G, 3 is with D.

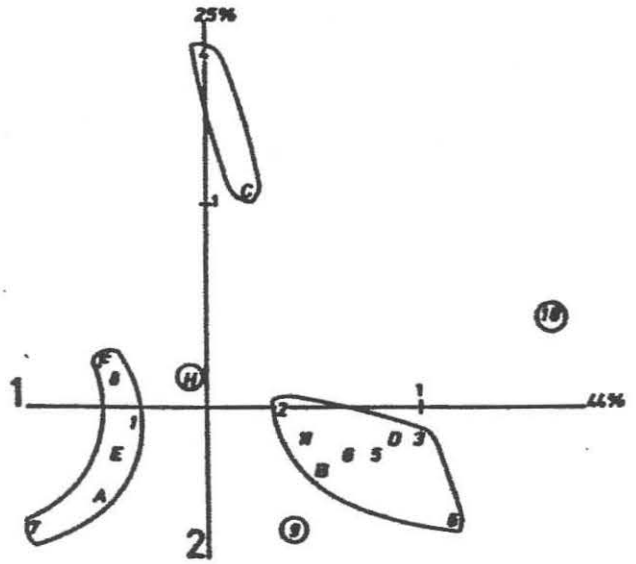

Figure 4. Ordination and Classification of data of *Bemisia tabaci* of Table (2). Symbols : bean varieties (A-H) and sampling dates (1-12) are as shown in Table (2).

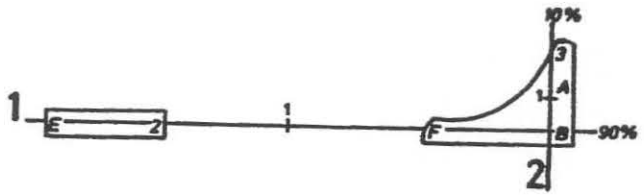

Figure 5. Ordination and Classification of data of *Tetranychus urticae* of Table (2). Symbols are the same as in Fig. (4). Points C, D, G, H and 12 are with B.

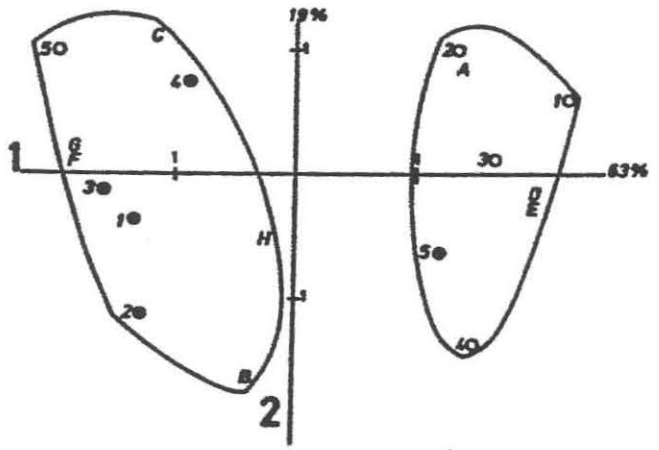

Figure 6. Ordination and Classification of data of the mean infestation rate of each pest of Tables (1 and 2). Symbols : bean varieties (A-H) are as shown in Tables (1 and 2), open circles = lower infestation rate, solid circles = higher infestation rate, 1 = *E. decipiens*, 2 = *L. congesta*, 3 = *A. cracciwora*, 4 = *B. tabaci*, 5 = *T. urticae*.

Application to data of infestation by the aphid, *A. craccivora* is shown in Fig. (3). 44 % of the total variance is associated with the first axis and 23 % with the second one. Generally, infestation of bean varieties by aphids is very low. Two bean varieties Giza 606 and Giza 669 are more infested for limited periods. Other bean varieties are more infested during two periods, the first is from 10 Dec. 1991 to 10 Feb. 1991 and the second is between 20 Mar. and 1 Apr. 1991.

Fig. (4) shows application to data on the rate of infestation by the whitefly *B. tabaci*. 44 % of the total variance is associated with the first axis and 25 % with the second one. Bean varieties Giza 502, Giza 523 and Giza 669 are more infested during three periods, the first is between 20-30 Dec. 1990, the second is between 20 Jan. and 1 Feb. 1991 and the third is on 20 Mar. 1991. Giza 402, Giza 605 and Giza 606 bean varieties are more infested on 20 Dec. 1990 and the period between 10 and 20 Feb. 1991. The other two bean varieties Giza 406 and Giza 503 are infested for a limited period.

Application to data of infestation by the red spider mite *T. urticae* is shown in Fig. (5). 90 % of the total variance is associated with the first axis and 10 % with the second one. Infestation by the red spider mite is confined only to 3 sampling dates. These dates are 20 and 30 Dec. 1990 and 1 Apr. 1991. All bean varieties are more infested on 1 Apr. 1991, except Giza 605 variety which is more infested on 20 Dec. 1990. The other 3 bean varieties are infested by *T. urticae* on other sampling dates. These bean varieties are Giza 402 and Giza 523 which are infested on 30 Dec. 1990 and Giza 606 infested on 20 Dec. 1990.

DISCUSSION

The results obtained in this study shows that all bean varieties are infested by *E. decipiens, L. congesta, A. craccivora, B. tabaci* and *T. urticae*, and none of the cultivars tested was found free of infestation. Analysis of variance showed no significcant differences between the faba bean varieties to pest infestation. These results are in agreement with those of Fam et al. (1987), who studied the susceptibility of 40 different faba bean cultivars to field infestation by the bean weevil *Bruchus rufimanus* Boh., and they found that all tested cultivars were susceptible to bruchid infestation.

The main results of the application of ordination and classification methods are the obtainment of groups as shown in Figs. 1 - 5. These methods are more appropriate when the method of analysis of variance is not sufficient. In ordination figures 1-5, maximum variance is between groups and minimum variance is within each of these groups (Goodall 1973). Relative susceptibility is reflected by the period of infestation. As shown in Fig. 1 Giza 402, Giza 406, Giza 502, Giza 503 and Giza 523 (one to two months each) have relatively lower infestation rates than varieties Giza 605, Giza 606 and Giza 669 (7 months of infestation) which have higher infestation rates. Accordingly, the shorter the infestation period, the lower is the infestation rate, and vice versa. Therefore, varieties Giza 402, Giza 406, Giza 502, Giza 503 and Giza 523 can be considered less susceptible than varieties Giza 605, Giza 606

and Giza 669, although the former were not completely free from infestation. They have at least the capacity to support pests for shorter periods and at less densities. Although Fig. 1 treats only data of infestation by *E. decipiens*, the same phenomenon is observable in the case of the other pests, but less clearly.

Higher infestation of whitefly at early sampling dates might be attributed to the migration of this pest bred on cotton to growing vegetable crops after uprooting of cotton plants from the fields (El-Borolossy et al. 1984). Number of whitefly decreased as bean varieties grow in age. Whitefly is completely absent from the last sampling date, on the other hand, the red spider mite *T. urticae* is not present in all sampling dates except a very few cases, but it present in last sampling date in higher numbers. This indicated that there is a negative association between *B. tabaci and T. urticae*. The initial infestation with the bean fly *L. congesta* was found on 20 Dec. 1990 and increased gradually till reaching its maximum in Apr. 1991 in all bean varieties. These results are in agreement with those of Metwally et al. (1986) who studied some ecological and morphological aspects on the broad bean fly *L. trifolii* (Burgess) at Zagazig region.

Data of the mean infestation rate of each pest are shown in Tables 1 and 2 were treated by CA and AHC methods after application of disjunctive coding method. This method comprises the categorization of data into groups or intervals with different levels (Roux 1987). The number of categories is variable as well as the border limit, as is desired. Data of the mean infestation rate of each pest were classified into lower and higher intervals. The upper limits of lower and higher intervals are : 0.46 and 0.96 for *E. decipiens*, 2.10 and 3.15 for L. congesta. 0.08 and 1.02 for *A. craccivora*, 8.98 and 17.21 for *B. tabaci* and 0.08 and 2.13 for *T. urticae*. The approach of this technique was to establish grouping of 3 or 4 bean varieties of lower mean infestation rate by each pest, as opposed to the remaining bean varieties with higher rates.

Fig. 6 shows reults of application of CA and AHC methods to data of the mean infestation rate by each pest after disjunctive coding. 63 % of the total variance is associated with the first (horizontal) axis and 19 % with the second (vertical) one. Giza 402, Giza 503 and Giza 523 appear to be less susceptible to infestation by *E. decipiens, L. congesta, A. craccivora and B. tabaci* and highly susceptible to infestation by the red spider mite *T. urticae*. Giza 406, Giza 502, Giza 605, Giza 606 and Giza 669 bean varieties appear to be highly susceptible to infestation by *E. decipiens, L. congesta, A. craccivora* and *B. tabaci* and less susceptible to infestation by *T. urticae*.

In Egypt, where cultural rotation follow rigid schedules and based on monoculture system for long period, open the way for pest infestation by providing concentrated resources and uniform physical conditions that encourage insect invasions (Altieri 1987). This will lead to the minimization of plant diversity, leading to the overwintering of such pests in the soil and elimination of pest natural enemies as a result of limited resources as well as application of insecticides during the period of cotton cultivation prior to faba bean cultivation in the

present study. In addition, the interchange of organisms among regions and even among crops causes, also, higher pest infestation. Increasing plant diversity through polyculture system throughout the year creating conditions suitable for beneficial organisms such as natural enemies (Altieri 1987). Two hypotheses explain pest reduction in polycultures (Altieri 1987). The first, the natural enemy hypothesis, predicts greater mortality of specialist and generalist insect pests in polyculture because of greater numbers of insect predators and parasites. The second hypothesis, the resource concentration hypothesis, predicts that specialized insect pests will be less abundant in polyculture when the mixture are composed of host and non-host crops. Therefore, we suggest to experiment with a mixture of bean varieties with the aim of avoiding heavly pest infestation, preferably in combination with other crop.

CONCLUSIONS

1- Periods of infestation are shorter (2 months) for varieties Giza 402, Giza 406, Giza 502, Giza 503 and Giza 523. Longer periods (7 months) are recorded for varieties Giza 605, Giza 606 and Giza 669.

2- Varieties Giza 402, Giza 503 and Giza 523 appear to be less susceptible to infestation by *E. decipiens, L. congesta, A. craccivora* and *B. tabaci* but highly susceptible to *T. urticae* and varieties Giza 406, Giza 502, Giza 605, Giza 606 and Giza 669 appear to be highly susceptible to infestation by *E. decipiens, L. congesta, A. craccivora* and *B. tabaci*, but less susceptible to *T. urticae*.

3- The most important factors affecting pest infestation appear to be the interchange of organisms among crops and even among regions and the monoculture system.

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حساسية بعض أصناف الفول البلدى للأصابة بالآفات الزراعية الرئيسية فى محافظة الفيوم

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مصر

أجريت التجربة فى الفترة من أكتوبر عام ١٩٩٠ الى أبريل عام ١٩٩١ وذلك بغرض دراسة حساسية ثمانية أصناف من الفول البلدى للأصابة بالآفات الزراعية الرئيسية فى محافظة الفيوم. ثم تحليل نتائج هذه الدراسة بالطرق المقدمة احصائيا مثل التحليل التوافقى والتقسيم الهيراركى، أظهرت الدراسة أن أصناف الفول كلها حساسة للأصابة بآفات المن والجاسيد والذبابة البيضاء والعنكبوت الأحمر ونبابة أوراق الفول، ولكن بدرجات متفاوتة وفى أعمار مختلفة لنمو النبات، وبصفة عامة فإن الأصناف جيزة ٤٠٢ وجيزة ٥٠٣ وجيزة ٥٢٣ حساسة بالأصابة بالآفات بدرجة قليلة، بينما أصناف جيزة ٤٠٦ ، جيزة ٥٠٢ ، جيزة ٦٠٥ ، جيزة ٥٠٦ ، جيزة ٦٦٩ حساسة للأصابة بالآفات الزراعية بدرجة عالية. وقد يكون سبب تعرض المحاصيل للأصابة هو أنتقال الافات من نبات الى آخر أو من منطقة الى أخرى، كذلك الأعتماد على زراعة المحصول الواحد خلال الدورة الزراعية قد يهيء الظروف المواتية لظهور هذه الآفات باعداد كبيرة.